IN THE SPECIFICATION:

Please amend paragraph **[0004]** as follows:

[0004] A conventional core barrel assembly typically includes an outer barrel assembly, a core bit, and an inner barrel assembly. Generally, a conventional outer barrel assembly comprises one or more hollow cylindrical sections, or "subs," which are typically secured end-to-end by threads. Secured to a lower end of the outer barrel assembly is the core bit, which is adapted to cut a cylindrical core and to receive the core in a central opening, or throat. The opposing upper end of the outer barrel assembly is attached to the end of a drill string, which conventionally comprises a plurality of tubular sections that extend to the surface. Disposed within the outer barrel assembly <u>is the inner barrel assembly,</u> ~~and~~ <u>which is</u> configured to receive the core as the core traverses the throat of the core bit and to retain the core for subsequent transportation to the surface, is the inner barrel assembly.

Please amend paragraph **[0008]** as follows:

[0008] Located within the outer barrel assembly, and releasably attached to the swivel assembly, is the inner barrel assembly. The inner barrel assembly includes an inner tube configured for retaining the core and a core shoe disposed at one end thereof adjacent the throat of the core bit. The core shoe is configured to receive the core as it enters the throat and to guide the core into the inner tube. A core catcher may be disposed proximate the core shoe to assist, in conjunction with the core shoe, in guiding the core into the inner tube and also to retain the core within the inner tube. Thus, as the core is ~~cut by~~ <u>cut by</u> application of weight to the core bit through the outer barrel assembly and drill string in conjunction with rotation of these ~~components the~~ <u>components, the</u> core will traverse the throat of the core bit to eventually reach the rotationally stationary core shoe, which accepts the core and guides it into the inner tube where the core is retained until transported to the surface for examination.

Please amend paragraph **[0018]** as follows:

[0018] Sponge liners are typically supplied in standard 5-ft or 6-ft sections, a number of which are placed end-to-end within the inner tube to substantially fill the ~~length,~~ length (usually a standard 30 feet) of the inner tube. The inner tube is typically constructed of a steel material and, as indicated above, the tubular sleeve of a conventional sponge liner comprises an aluminum material. Due to the differences in material properties of the tubular sleeve and the inner tube, the coefficient of thermal expansion for aluminum is approximately twice that of steel, and the long extent of the inner tube and sponge liners disposed end-to-end therein, the conventional sponge core barrel assembly routinely experiences differential thermal expansion. Differential thermal expansion between the inner tube and sponge liners may occur longitudinally along the length of the inner tube as well as radially. Differential thermal expansion may cause mechanical damage to components of the sponge core barrel assembly and may also damage the core sample.

Please amend paragraph **[0020]** as follows:

[0020] As noted above, flow split is the result of the flow of drilling fluid from the annular region between the inner and outer barrel assemblies and through a narrow annulus that exists between the bit body and the core shoe, to be exhausted through an annular gap near the throat of the core bit and proximate the core sample. The annular gap is defined by a longitudinal distance between the lower end of the core shoe and the bit body. The width of the annular ~~gap and,~~ gap and, hence, the volume of flow ~~split is~~ split, is a function of the difference between the longitudinal length of the outer barrel assembly and the longitudinal length of the inner barrel assembly; the inner barrel assembly being suspended at its upper end from a swivel assembly disposed proximate the upper end of the outer barrel assembly. Although the provision of a narrow annulus and annular gap may result in flow split, the narrow annulus and annular gap are necessary as the clearance between the core shoe and the bit body provided by the narrow annulus and annular gap enables the outer barrel assembly and core bit to rotate freely relative to the inner barrel assembly. Thus, it is desirable to maintain the width of the annular gap at a controlled, minimum distance.

Please amend paragraph **[0027]** as follows:

[0027] Conventional coring ~~operations not~~ operations, not including conventional sponge ~~coring are~~ coring, are routinely performed using core barrel lengths of 60 feet, 90 feet, 120 feet, or longer. Make up of the outer barrel assembly typically comprises interconnecting the various components of the outer barrel assembly while suspending the outer barrel through the floor of the drilling rig. In other words, each component of the outer barrel assembly is individually or, in conjunction with other attached components, lifted off the rig floor and secured to the partially assembled outer barrel (i.e., those components already assembled), which is suspended from the rig floor. Subsequently, the inner barrel assembly is rigged up section-by-section within the outer barrel assembly, interconnections between the inner barrel sections being made just above the upper end of the outer barrel assembly. The inner barrel assembly is then secured to a swivel assembly that is attached to the outer barrel assembly, the swivel assembly rotationally isolating the inner barrel assembly from the outer barrel assembly.

Please amend paragraph **[0028]** as follows:

[0028] By way of example, a 90-ft outer barrel assembly having a core bit secured to a lower end thereof may be rigged up and suspended through the rig floor. A first 30-ft section of inner barrel having a core shoe at a lower end thereof is then lowered into the outer barrel assembly, a portion of the upper end of the first inner barrel section extending above the outer barrel assembly. Next, a second 30-ft section of inner barrel is lifted off the rig floor and a lower end thereof is connected to the upper end of the first inner barrel section, the first and second inner barrel sections then being lowered into the outer barrel assembly with a portion of the upper end of the second inner barrel section extending above the outer barrel assembly. A third 30-ft section of inner barrel is then lifted off the rig floor and a lower end of this third section is connected to the upper end of the second inner barrel section. The first, second, and third interconnected inner barrel sections are then lowered into the outer barrel assembly. Additional components may be secured to the upper end of the third inner barrel section, such as a pressure

relief plug and drop ball. The first, second, and third inner barrel ~~sections the~~ sections (the inner barrel ~~assembly is~~ assembly) are then secured to a swivel assembly that is attached to the outer barrel assembly. The upper end of the outer barrel assembly is subsequently secured to the lower end of a drill string for coring.

Please amend paragraph **[0038]** as follows:

[0038] A further embodiment of the present invention includes a piston assembly configured to provide a fluid seal proximate the lower end of the inner barrel assembly for retaining presaturation fluid under pressure within the inner barrel assembly. The piston assembly comprises a cylindrical piston having a central bore therethrough and a piston rod slidably disposed within the central bore. The piston assembly may also include a seal, such as an ~~O ring type~~ O-ring-type seal, disposed between the interior wall of the inner barrel assembly and the cylindrical piston and providing a fluid seal therebetween. The piston assembly further includes one or more locking elements disposed about the circumference of the piston and radially extendable and retractable therethrough. In a radially outermost position, each locking element is configured to engage an annular groove in the interior wall of the inner barrel assembly, securing or locking the piston assembly at a fixed longitudinal position near the lower end of the inner barrel assembly above the throat of the core bit.

Please amend paragraph **[0070]** as follows:

[0070] FIGS. 2 through 4 show a portion of a sponge liner 240 according to the present invention. The sponge liner 240 comprises an annular sponge layer 241 contained within a sleeve 242. The annular sponge layer 241 may be constructed of any suitable absorptive material as known in the art, the specific material employed being application dependent. For example, annular sponge layer 241 may be constructed of a material adapted to readily absorb a specific reservoir fluid of interest, such as oil or water. The annular sponge layer 241 forms a central interior cavity 247 of a diameter substantially equal to the outside diameter of the core sample 5, such that the annular sponge layer 241 substantially contacts the outer cylindrical surface of the

core sample 5. Sleeve 242 is a generally tubular structure surrounding the annular sponge layer 241 and providing structural strength and rigidity to the sponge liner 240. Also, the sleeve 242 may include a plurality of holes or other perforations 249 enabling reservoir gases entrained in the core sample 5 to expand and escape therethrough. The sleeve 242 may be constructed of any suitable material including aluminum, fiberglass, and other epoxy- or ~~resin-based~~ resin-based composite materials.

Please amend paragraph **[0073]** as follows:

[0073] Further structural strength may be imparted to the annular sponge layer 241 by a webbing layer 246. Webbing layer 246 comprises a webbing of any suitable pattern or configuration that is immersed ~~within or~~ within, or molded ~~into the~~ into, the annular sponge layer 241. Although the webbing layer 246 is shown in FIGS. 2-3 as being disposed proximate the interior surface 245 of the annular sponge layer 241, it should be understood that the webbing layer 246 may be disposed at any suitable location within the radial thickness of the annular sponge layer 241. The webbing layer 246 may comprise any suitable material known in the art, such as, by way of example, polyethylene filament or nylon filament, that does not interfere with the absorption of reservoir fluids by the annular sponge layer 241.

Please amend paragraph **[0077]** as follows:

[0077] Make up of an inner barrel assembly 200 according to this embodiment of the invention may include interconnecting one or more integrated sponge barrels 280, while insertion of separate sponge ~~liners,~~ liners (as well as shims, as described below) into an inner tube section 210a, 210b, 210c is not required. Further, an integrated sponge barrel 280 has only a single outer material layer comprised of the inner tube section 282; the integrated sponge barrel 280 does not include a sleeve 242 constructed from a first material surrounding the annular layer of sponge material 281 and encased within an inner tube constructed of a second, different material. Thus, use of one or more integrated sponge barrels 280 simplifies assembly of the inner

barrel assembly 200 and eliminates differential thermal expansion between the inner tube sections 210a, 210b, 210c and sponge liner or liners.

Please amend paragraph **[0081]** as follows:

[0081] Referring to FIG. 7, piston assembly 400 comprises a piston rod 420 comprising an outer cylindrical surface 421 slidably disposed within a bore 411 of a cylindrical piston 410, the piston 410 having an upper end 416 and a lower end 417. The piston 410 is seated within the lower end 212a of the lowermost inner tube section 210a. It should be noted that, although referred to herein as being part of the lowermost inner tube section 210a, the lower end 212a of the lowermost inner tube section 210a is often referred to as the upper core shoe 220 and may be a separate tubular section attached by threads to the lowermost inner tube section 210a. However, the specific configuration of the inner barrel assembly ~~200 and~~ 200 and the particular terminology ~~employed is~~ employed is immaterial to the present invention, and those of ordinary skill in the art will understand that the various aspects of the present invention are applicable to any core barrel configuration, regardless of the particular structure and the terminology used to describe such structure.

Please amend paragraph **[0082]** as follows:

[0082] An ~~O ring type~~ O-ring-type seal 470 is disposed within an annular groove 215 in the interior wall of the lowermost inner tube section 210a, the ~~O ring type~~ O-ring-type seal 470 providing a fluid seal between the lowermost inner tube section 210a and the outer cylindrical surface 412 of the piston 410. Any other suitable type of seal as known in the art may be used to provide the fluid seal between the lowermost inner tube section 210a and the piston 410. One or more locking elements 440 are disposed about the circumference of the piston 410. Each locking element 440 is configured to freely move within a passageway 413 extending radially through the piston 410. In its radially outermost position, as shown in FIG. 7, each locking element 440 is configured to engage an annular groove 217 in the wall of the lowermost inner tube section 210a. With the ends 442 of the locking elements 440 extending

into the annular groove 217, the piston 410 is in the locked condition and the relative longitudinal position (along longitudinal axis 12 of the sponge core barrel assembly 10) of the piston 410 within the lowermost inner tube section 210a is fixed. Thus, in the locked condition, the outer cylindrical surface 412 of the piston 410 is able to interface with the ~~O ring type~~ O-ring-type seal 470 disposed within annular groove 215 in the interior wall of lowermost inner tube section 210a, thereby providing the fluid seal between the piston 410 and lowermost inner tube section 210a.

Please amend paragraph **[0084]** as follows:

[0084] The end of bore 422 is sealed by a cylindrical plug 454 extending from a retaining element 450. The cylindrical plug 454 may be secured within the bore 422 of piston rod 420 using any suitable connecting method such as, for example, a threaded connection or an interference press fit. An ~~O ring type~~ O-ring-type seal 460, or any other suitable type of seal as known in the art, resting within an annular groove 414 in the wall of bore 411 of piston 410 provides a fluid seal between the piston rod 420 and the piston 410. Thus, the fluid seal provided by the cylindrical plug 454 disposed in the end of bore 422 of piston rod 420, the fluid seal provided by the ~~O ring type~~ O-ring-type seal 460 disposed between the piston rod 420 and piston 410, as well as the fluid seal provided by the ~~O ring type~~ O-ring-type seal 470 disposed between the piston 410 and the lowermost inner tube section 210a, all function to prevent the leakage of presaturation fluid from chamber 216a (or chamber 205) and around piston assembly 400 when the piston 410 and associated locking elements 440 are in the locked condition.

Please amend paragraph **[0085]** as follows:

[0085] The retaining element 450, secured to piston rod 420 by cylindrical plug 454 as noted above, retains the piston rod 420 within the bore 411 of piston 410. Gravitational forces, frictional forces exerted on the piston rod 420 by the ~~O ring type~~ O-ring-type seal 460, and forces exerted on the upper surface 452 of the retaining element 450 due to presaturation fluid

pressure within chamber 216a (or chamber 205) maintain the piston rod 420 in its lowermost position, with the lower surface 451 of the retaining element 450 contacting the upper end 416 of the piston 410. As will be described in greater detail below, the presaturation fluid pressure is limited by a pressure compensated inner barrel assembly 200 and, accordingly, any downwardly directed forces on the piston rod 420 as a result of the presaturation fluid pressure are minimized. Also, because the retaining element 450 does not extend radially to the interior wall of the lowermost inner tube section 210a, friction therebetween is nonexistent.

Please amend paragraph **[0086]** as follows:

[0086] The interface between the lower surface 451 of the retaining element 450 and the upper end 416 of the piston 410 is not intended to provide a fluid seal, the necessary fluid seal being provided by the ~~O ring type~~ <u>O-ring-type</u> seal 460, and, therefore, the lower surface 451 of the retaining element 450 may be subjected to the pressurized presaturation fluid within chamber 216a (or chamber 205). The exposed area of lower surface 451 is reduced in comparison to the exposed area of upper surface 452 only to the extent that the center portion of lower surface 451 is not exposed to presaturation fluid. Thus, the force exerted on the lower surface 451 as a result of pressurized presaturation fluid may not be significantly less than the corresponding force exerted on the upper surface 452.

Please amend paragraph **[0095]** as follows:

[0095] In prior art piston-type sealing mechanisms, the piston was retained in the inner tube and the presaturation fluid contained within the inner tube, solely by frictional forces exerted on the piston. An O-ring in contact with the piston and the inner tube and providing a seal therebetween, as well as surfaces of the piston and inner tube in contact, provided the necessary frictional forces. In order to hold the piston in place against the forces exerted thereon by presaturation fluid held within the inner tube under pressure (in some instances, high pressure), these frictional forces are necessarily relatively high. Therefore, when the core contacts the piston, the core must apply a starting force on the piston large enough to overcome

the static frictional forces exerted thereon and the forces exerted on the piston by the pressurized presaturation fluid. Once the piston has been moved a small distance, the seal provided by the ~~O-ring~~ O-ring will be broken and the presaturation fluid released, thereby lowering the force required to move the piston through the inner tube. Nonetheless, a large starting force is necessary to initiate movement of the piston and break the seal, and this large starting force may cause structural damage to the core sample 5.

Please amend paragraph **[0096]** as follows:

[0096] The piston assembly 400 according to the present invention, however, does not suffer from a significant weakness of the prior art (i.e., a large starting force to initiate movement of the piston). As indicated previously, the presaturation fluid is discharged ~~from or~~ from, or is at least beginning to flow out ~~of the~~ of, the chamber 205 within the inner barrel assembly 200 prior to any upward longitudinal movement of the piston 410. Thus, forces on the piston 410 resulting from the presaturation fluid pressure are substantially non-existent during translation of the piston 410. Also, because the piston 410 is positively locked into position by the locking elements 440, high frictional forces between the piston 410 and the interior wall of the lowermost inner tube section ~~210a,~~ 210a (whether provided by an O-ring-type seal 460 or resulting from contact between the piston 410 and lowermost inner tube section 210a) are not necessary to maintain the position of the piston 410 prior to contact with the core sample 5.

Please amend paragraph **[0097]** as follows:

[0097] Because the piston 410 is mechanically locked by the locking elements 440, which are free-floating, the piston rod 420 is mechanically isolated from the piston 410 (i.e., the piston rod 420 can move freely within the bore 411 of piston 410 with little or no resistance to movement therefrom). Thus, as was suggested above, to move the piston rod 420 and unlock the piston 410, a core sample 5 must apply a force on the lower planar surface 434 of piston rod 420 sufficient to overcome the gravitational force, the force exerted on the piston rod 420 by the ~~O-ring type~~ O-ring-type seal 460, and the force exerted on the retaining element 450 as a result of

presaturation fluid pressure. The gravitational force and, by appropriate design, the force exerted on the piston rod 420 by the ~~O-ring type~~ O-ring-type seal 460 will be relatively small. Further, the pressure exerted on the upper surface 452 of the retaining element 450 is limited by the pressure compensated chamber 205 within inner barrel assembly 200, as will be described in greater detail below. Therefore, in comparison to prior art piston-type sealing mechanisms, the force necessary to activate the piston assembly 400 of the present invention is relatively small and mechanical damage to the core sample 5 minimized.

Please amend paragraph **[0098]** as follows:

[0098] Referring to FIG. 8, disposed proximate the upper end 214c of the uppermost inner tube section 210c are the pressure compensation mechanism 500 and the thermal compensation mechanism 600. The pressure compensation mechanism 500 comprises a cylindrical housing 510 having an outer cylindrical surface 515 of a diameter substantially equal to, although slightly less than, the inside diameter of the uppermost inner tube section 210c. An ~~O-ring type~~ O-ring-type seal 540, or any other suitable type of seal as known in the art, may be disposed within an annular groove 516 in the cylindrical housing 510. The ~~O-ring type~~ O-ring-type seal 540 provides a fluid seal between the cylindrical housing 510 and the interior wall of the uppermost inner tube section 210c. Thus, the pressure compensation mechanism 500 and the piston assembly 400 provide the upper and lower fluid seals, respectively, for the presaturation fluid chamber 205 within inner barrel assembly 200.

Please amend paragraph **[00100]** as follows:

[00100] During coring, thermal expansion of the presaturation fluid as a result of high downhole temperature and compression of the core barrel assembly due to high downhole pressure may cause the presaturation fluid pressure within the chamber 205 to increase significantly. Whenever the presaturation fluid pressure within chamber 205 reaches the specified limit of the pressure relief element 520, however, the pressure relief element 520 will release a limited volume of presaturation fluid sufficient to lower the presaturation fluid pressure

to within the specified limit. Thus, pressure compensation mechanism 500 provides a ~~mechanism — i.e.,~~ mechanism (i.e., pressure relief element ~~520 — for~~ 520) for continually compensating for changes in fluid pressure within the inner barrel assembly 200, regardless of the cause of the pressure increase.

Please amend paragraph **[00104]** as follows:

[00104] During make up ~~of a~~ of the sponge core barrel assembly 10, one or more sponge liners 240 are disposed within the uppermost inner tube section 210c to substantially fill the length thereof, leaving only a relatively small nonlined length of tube proximate the upper end 214c of the uppermost inner tube section 210c. The adjusting sleeve 610 of thermal compensation mechanism 600 with attached pressure compensation mechanism 500 is then disposed in the uppermost inner tube section 210c, such that the lower bearing surface 615 on the flange 614 at the lower end 613 of the tubular body 611 of adjusting sleeve 610 rests against the upper end of the sponge liner 240 (or uppermost sponge liner 240, if more than one). The outer bearing surface 617 on the flange 614 is slidably disposed against the interior wall of the uppermost inner tube section 210c. With the lower bearing surface 615 abutting the end of the sponge liner 240, a gap 250c will exist between the shoulder 211c on the wall of the uppermost inner tube section 210c and the upper bearing surface 616 on the flange 614.

Please amend paragraph **[00107]** as follows:

[00107] During differential thermal expansion, the sponge liner 240 (or uppermost sponge liner 240, if more than one) will push upwardly against the lower bearing surface 615 of the flange 614 at the lower end 613 of the adjusting sleeve 610, causing the adjusting sleeve 610 and attached pressure compensation mechanism 500 to move upwards longitudinally along longitudinal axis 12. Longitudinal movement of the adjusting sleeve 610 and attached pressure compensation mechanism 500 is guided, at the lower end 613 thereof, by the outer bearing surface 617 on the adjusting sleeve 610 and, at the upper end thereof, by the outer cylindrical surface 515 of cylindrical housing 510. The ~~O ring type~~ O-ring-type seal 540 maintains the fluid

seal between the uppermost inner tube section 210c and the cylindrical housing 510 during longitudinal movement thereof.

Please amend paragraph **[00113]** as follows:

[00113] In a further alternative embodiment, as shown in FIG. 11, a valve assembly 900 comprises a lower seal assembly 920 and an upper seal assembly 940. The lower seal assembly 920 is secured to, for example, the upper end 214a of the lowermost inner tube section 210a, and the upper seal assembly 940 is secured to the lower end 212b of the intermediate inner tube section 210b. After presaturation of the individual inner tube sections 210a, 210b, 210c and make up of the inner barrel assembly 200, the lower seal assembly 920 is secured to the upper seal assembly 940. The lower seal assembly 920 comprises a housing 922 and a sealing element 924 retained therein. In this embodiment, sealing element 924 comprises a releasable piston 925 held in place by a retaining element 960. Retaining element 960 may comprise a threaded bolt impinging against the outer cylindrical surface of the releasable piston 925, as shown in FIG. 11, or any other suitable device known in the art, such as a clamp or a retaining pin. The releasable piston 925 is to provide a fluid seal between the outer cylindrical surface of the releasable piston 925 and the interior wall of the lower seal assembly housing 922 configured as by, for example, appropriate dimensioning or by the inclusion of an ~~O-ring type~~ O-ring-type seal (not shown). When the releasable piston 925 is released via actuation of the retaining element 960, the releasable piston 925 is free-floating within the inner barrel assembly 200. The upper seal assembly 940 comprises a housing 942 and a sealing element 944 secured therein, the sealing element 944 comprising a generally planar diaphragm 945. When the lower and upper seal assemblies 920, 940 are interconnected, a chamber 905 is formed between the sealing element 924 of lower seal assembly 920 and the sealing element 944 of the upper seal assembly 940.

Please amend paragraph **[00114]** as follows:

[00114] The planar diaphragm 725 of the valve assembly 700, the dome-shaped diaphragms 825, 845 of the valve assembly 800, and the planar diaphragm 945 of the valve assembly 900 may be constructed of any suitable material as known in the art, so long as the diaphragms 725, 825, 845, 945 fail, or rupture, upon application of the appropriate load or fluid pressure, as will be explained below. The diaphragms 725, 825, 845, 945 may be secured within their respective housings 722, 822, 842, 942 by any suitable method known in the art. For example, the diaphragms 725, 825, 845, 945 may be adhesively bonded to or, alternatively, molded into, annular grooves 726, 826, 846, 946 in the housings 722, 822, 842, 942, respectively.

Please amend paragraph **[00115]** as follows:

[00115] In the assembled inner barrel assembly ~~200 comprising~~ 200 comprising lowermost inner tube section 210a, intermediate inner tube section 210b, and uppermost inner tube section ~~201c the~~ 201c, the valve assemblies 700, 800, 900 provide fluid seals between successive inner barrel sections. Accordingly, the lowermost inner tube section 210a, having piston assembly 400 at its lower end 212a and lower seal assembly 720 of valve assembly 700 (or lower seal assembly 920 of valve assembly 900) at its upper end 214a, forms a sealed chamber 216a that may individually be filled with presaturation fluid. Similarly, the intermediate inner tube section 210b, having upper seal assembly 740 of valve assembly 700 (or upper seal assembly 940 of valve assembly 900) at its lower end 212b and lower seal assembly 820 of valve assembly 800 at its upper end 214b, forms a sealed chamber 216b, and the uppermost inner tube section 210c, having upper seal assembly 840 of valve assembly 800 at its lower end 212c and pressure compensation mechanism 500 at its upper end 214c, forms a sealed chamber 216c, each of which may individually be filled with presaturation fluid. Thus, the inner tube sections 210a, 210b, 210c may be individually presaturated and then subsequently interconnected to form inner barrel assembly 200.

Please amend paragraph **[00117]** as follows:

[00117] Opening of the valve assemblies 700, 800, 900 may be performed by employing any one of a number of methods and/or devices, or a combination thereof. For example, referring again to FIG. 9, the valve assembly 700, having a lower seal assembly 720 including a sealing element 724 comprised of a generally planar diaphragm 725 and an upper seal assembly 740 including a sealing element 744 comprised of a ball valve 745, may be opened by first rupturing the planar diaphragm 725 and subsequently opening the ball valve 745. The planar diaphragm 725 may be ruptured by the compression of fluid within chamber 705 during the interconnection of the lower and upper seal assemblies 720, 740. Alternatively, after the lower and upper seal assemblies 720, 740 have been interconnected, a known volume of presaturation fluid may be introduced into the chamber 705 through a tap 751 to create a fluid pressure within chamber 705 sufficient to burst the planar diaphragm 725. The valve assembly 700 may also be opened by first opening the ball valve 745, creating a differential fluid pressure across the planar diaphragm 725 sufficient to rupture the planar diaphragm 725.

Please amend paragraph **[00119]** as follows:

[00119] Referring to FIG. 11, the valve assembly 900, having a lower seal assembly 920 including a sealing element 924 comprised of a releasable piston 925 and an upper seal assembly 940 including a sealing element 944 comprised of a generally planar diaphragm 945, may be opened by rupturing the planar diaphragm 945 and subsequently releasing the releasable piston 925; the releasable piston 925 then being free-floating within the inner barrel assembly 200. The planar diaphragm 945 may be ruptured by compression of fluid within chamber 905 upon interconnection of the lower and upper seal assemblies 920, 940. Alternatively, the valve assembly 900 may include a tap 751 (see FIG. 9) for introducing a volume of presaturation fluid into the chamber 905 to create a fluid pressure within chamber 905 sufficient to burst the~~ releasable piston 925.~~ planar diaphragm 945.

Please amend paragraph **[00127]** as follows:

[00127] For either of the core barrel assemblies shown and described with respect to FIGS. 1A-1C and 12A-12C, respectively, friction between the sponge-lined inner barrel assembly 200 and the core sample 5 may be significantly reduced by using one or more sponge liners 240 or, optionally, one or more integrated sponge barrels 280, according to the invention. Specifically (see FIG. 2), a layer of webbing material 246 may be molded into or immersed within the annular sponge layer 241 of the sponge liner or liners 240, or a layer of webbing material 286 may be molded into or immersed within the annular layer of sponge material 281 of the integrated sponge barrel or barrels 280. Reducing friction between the core sample 5 and inner barrel assembly 200 can protect against fracture of the core sample 5, thereby improving core integrity, especially for an extended-length inner barrel assembly 200 (i.e., one having a length greater than the conventional 30 feet).

Please amend paragraph **[00128]** as follows:

[00128] In a further embodiment of the present invention, the sponge core barrel assembly 10 includes a swivel assembly disposed proximate the core bit. Conventionally, the swivel assembly in a core barrel is disposed proximate the upper end of the outer barrel assembly and the upper end of the inner barrel assembly is secured to the swivel assembly such that the inner barrel assembly is suspended therefrom within the outer barrel assembly. The swivel assembly, therefore, supports the inner barrel assembly within the outer barrel assembly~~ and~~ ~~through~~ and, through the action of one or more~~ bearings~~ ~~enables~~ bearings, enables the outer barrel assembly to rotate freely relative to the inner barrel assembly. If differential thermal expansion exists between the inner and outer bearing assemblies, the lower end of the inner barrel assembly (i.e., the core shoe 220) expands towards, or away from, the lower end of the outer barrel assembly (i.e., the bit body) longitudinally along the longitudinal axis 12 of the core barrel. Such differential thermal expansion may result in mechanical damage to components of a core barrel or lead to increased flow split, as noted above. The present invention solves this problem by positioning a swivel assembly proximate the core bit (i.e., a "near-bit" swivel

assembly) and allowing the inner barrel assembly to thermally expand longitudinally upwards therefrom unimpeded. Employing a near-bit swivel assembly according to the present invention eliminates the conventional swivel assembly secured to the upper end of the inner barrel assembly and located proximate the upper end of the outer barrel assembly, thereby enabling the upper end of the inner barrel assembly to move freely within the outer barrel assembly.

Please amend paragraph **[00129]** as follows:

[00129] Referring to FIG. 13, an exemplary embodiment of a near-bit swivel assembly 1000 according to the present invention is shown disposed proximate the lower end 212a of the lowermost inner tube section 210a adjacent a core bit 300a. The core bit 300a is essentially the same as the core bit 300 shown in FIGS. 1A-1C, and may include a plurality of cutters 310a, except that the core bit 300a is further configured for use with near-bit swivel assembly 1000, as will be described. The near-bit swivel assembly 1000 includes one or more bearing assemblies, such as, for example, a radial bearing assembly 1020 and a thrust, or axial, bearing assembly 1040. The radial bearing assembly 1020 maintains the inner barrel assembly 200 in the proper radial position and orientation relative to the outer barrel assembly 100, and the thrust bearing assembly 1040, in conjunction with a shoulder 340a and latch mechanism 350a disposed on the interior wall of the core bit 300a, as described below, maintains the inner barrel assembly 200 in the proper longitudinal position and orientation with respect to the outer barrel assembly 100. Also, the thrust bearing assembly 1040 bears the weight of the inner barrel assembly 200. The radial and thrust bearing assemblies 1020, 1040, <u>respectively,</u> cooperate to allow the outer barrel assembly 100 and core bit 300a to rotate freely with respect to the inner barrel assembly 200.

Please amend paragraph **[00133]** as follows:

[00133] An opposing lower surface 1048 of the thrust plate 1042 rests against a shoulder 340a provided on the interior wall of the core bit 300a to maintain the lower end of the inner barrel assembly 200 (i.e., the core shoe 220) at a desired longitudinal distance from the

throat 320a of the core bit 300a. Also disposed on the interior wall of the core bit 300a are one or more latch mechanisms 350a. A latch mechanism 350a is configured to allow passage thereby of the core shoe 220 and the lower end 212a of the lowermost inner tube section 210a during insertion of the inner barrel assembly 200 into the outer barrel assembly 100, and is further ~~configured in~~ configured, in conjunction with the shoulder ~~340a to~~ 340a, to maintain the inner barrel assembly 200 in the proper longitudinal position within the outer barrel assembly 100. The latch mechanism 350a may be any suitable latching or locking mechanism known in the art capable of retaining the inner barrel assembly 200 in the proper longitudinal position.

Please amend paragraph **[00138]** as follows:

[00138] One or more sponge liners 240 are then disposed within the lowermost inner tube section 210a. A single sponge liner 240 substantially equivalent in length to the length of the lowermost inner tube section ~~210a which~~ 210a (which may be 30 feet, 45 feet, 60 feet, or any other suitable ~~length or,~~ length) or, alternatively, a plurality of sponge liners 240 may be disposed within the lowermost inner tube section 210a and stacked end-to-end to fill substantially the entire length of the lowermost inner tube section 210a.

Please amend paragraph **[00143]** as follows:

[00143] One or more sponge liners 240 are then disposed within the intermediate inner tube section 210b. A single sponge liner 240 substantially equivalent in length to the length of the intermediate inner tube section ~~210b which,~~ 210b (which, again, may be 30 feet, 45 feet, 60 feet, or any other suitable ~~length or,~~ length) or, alternatively, a plurality of sponge liners 240 may be disposed within the intermediate inner tube section 210b and stacked end-to-end to fill substantially the entire length of the intermediate inner tube section 210b.

Please amend paragraph **[00156]** as follows:

[00156] The valve assembly 700 (or valve assembly 900) is then actuated to join the chamber 216a within lowermost inner tube section 210a with the chamber 216b of intermediate inner tube section 210b. Actuation of the valve assembly 700 requires rupturing of the generally planar diaphragm 725 comprising the sealing element 724 of the lower seal assembly 720 and opening of the ball valve 745 comprising the sealing element 744 of the upper seal assembly 740. Again, rupturing of the planar diaphragm 725 may be performed by introducing presaturation fluid through a tap 751 into the chamber 705 formed between the sealing elements 724, 744 to burst the planar diaphragm 725, by compression of fluid within the chamber 705 during interconnection of the lower and upper seal assemblies 720, 740, by a pressure differential created across the planar diaphragm 725 upon opening of the ball valve 745, or by a combination thereof.

Please amend paragraph **[00164]** as follows:

[00164] For any of the embodiments described in FIGS. 1A-1C, 7, 8, 9, 10, 11, and 12A-12C, the interconnected inner tube sections 210a, 210b, 210c comprise an inner barrel assembly 200 having a single, continuous interior chamber 205 for retaining presaturation fluid. The chamber 205, which is substantially lined with sponge material, can retain a single core sample having a length substantially equal to the sum of the individual lengths of the inner tube sections 210a, 210b, and 210c. Thus, by employing an inner barrel assembly 200 according to any embodiment of the present invention, sponge coring operations can be conducted with significantly fewer trip-outs of the drill string from the bore hole while, at the same time, obtaining a core sample having a length greater than the conventional ~~30 foot~~ 30-ft length.

Please amend paragraph **[00179]** as follows:

[00179] A core sample 5 having a length substantially equal to the sum of the lengths of the inner tube sections 210a, 210b, 210c, as well as having high structural integrity, can then be cut. Tripping of the drill string from the bore hole will not be necessary prior to cutting the entire

length of the core sample 5, which core sample length may comprise~~45 ft, 60 ft, 90 ft,~~ 45 feet, 60 feet, 90 feet, or a longer length, as desired. When coring is complete, the sponge core barrel assembly 10 can be tripped from the bore hole, the inner barrel assembly 200 removed from the outer barrel assembly 100, and the core sample 5 removed therefrom. The core sample 5 may be retained in the sponge liner or liners 240 for shipment and subsequent analysis and, if integrated sponge barrels 280 are employed, the core sample 5 may be contained directly in the integrated sponge barrels 280 for transportation. If a webbing layer 246, 286 is provided in the annular sponge layers 241, 281, friction between the core sample 5 and annular sponge layers 241, 281 can be significantly reduced and core integrity preserved.

Please amend paragraph **[00180]** as follows:

[00180] In a further alternative embodiment of the present invention, coring operations are performed using a sponge core barrel assembly 10 including a near-bit swivel assembly 1000. Coring with a sponge core barrel assembly 10, including the near-bit swivel assembly 1000, proceeds as described above; however, the lower end of the inner barrel assembly 200 (lower end 212a of lowermost inner tube section 210a) is supported by the near-bit swivel assembly 1000 and the upper end of the inner barrel assembly 200 (upper end 214c of uppermost inner tube section 210c) is allowed to freely thermally expand upwards within the outer barrel assembly 100, thereby compensating for differential thermal expansion between the inner barrel assembly 200 and the outer barrel assembly 100. Coring with a near-bit swivel assembly 1000 may be desirable when the inner tube sections 210a, 210b,~~210c or,~~ 210c (or, alternatively, the integrated sponge barrels~~280 comprising~~ 280) comprising the inner barrel assembly 200 are comprised of aluminum, which thermally expands at approximately twice the rate of steel, which is the material typically used to construct the outer barrel assembly 100.

Please amend paragraph **[00185]** as follows:

[00185] A sponge core barrel assembly 10 according to the present invention may also include a near-bit swivel assembly 1000. The near-bit swivel assembly 1000 supports the lower

end of the inner barrel assembly 200 proximate the core bit 300a, while enabling the outer barrel assembly 100 to rotate freely relative to the inner barrel assembly 200. The upper end of the inner barrel assembly 200 is, therefore, allowed to move freely within the outer barrel assembly 100, thereby compensating for differential thermal expansion between the inner and outer barrel assemblies 200, 100. Although the exemplary embodiment of a near-bit swivel assembly 1000 is shown and described herein in the context of a sponge core barrel and performing sponge coring operations, those of ordinary skill in the art will appreciate that a ~~near-bit~~ near-bit swivel assembly according to the present invention is generally applicable to all types of coring systems and methods of coring.